Implementing CD-Based Wetland Delineation Training

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PURPOSE: This technical note presents an implementation plan for the development of a CD- or Internet-based tutorial for individual instruction in wetland identification and delineation. The tutorial is aimed primarily at new personnel in the Corps Regulatory program, and will also be useful as a ready reference and refresher for experienced delineators.

BACKGROUND: Currently, wetland delineation training is provided mainly through the PROSPECT course "Regulatory IV – Interagency Wetland Identification and Delineation." This 36-hour course includes about 15 hours of classroom instruction plus four half-days in the field delineating wetlands. The strong field component is unusual for a PROSPECT class and makes Regulatory IV difficult, if not impossible, to duplicate in an instructional software package. Field exercises are a critical component of wetland delineation training. They give students practical experience with sampling and interpreting soils, vegetation, and hydrology, and integrating these data into a wetland boundary decision.

Development of a computerized wetland delineation tutorial is not intended to replace or reduce the need for the traditional Regulatory IV class. However, the national PROSPECT class is currently offered only once or twice per year, usually in the spring. New hires in the Regulatory program sometimes must wait a year or more before they can schedule the class. Furthermore, even experienced regulators could benefit from occasional review of wetland delineation procedures or updates on new guidance or resources. The needs of both new hires and experienced delineators can be met through instructional software that is easily updated and available on demand at the user's personal computer.

REVIEW OF EXISTING TUTORIALS: The first step in this planning study was to review other examples of CD- and Internet-based training modules on technical subjects for ideas on the organization and presentation of information that would be relevant to wetland delineation training. Some examples are listed in Table 1. They range from relatively simple and inexpensive to more sophisticated and costly.

A no-frills approach to individual instruction is represented by the U. S. Environmental Protection Agency's Watershed Academy Web (*http://www.epa.gov/watertrain/*), which is an Internet-based selection of dozens of instructional modules and documents on various topics in watershed ecology and management. The examples reviewed in Table 1 (item 1) are essentially slide or PowerPoint® presentations, with the slide image and some explanatory text displayed side by side on the computer screen. The "lesson" must be viewed in sequence (Next slide, please!). Potentially unfamiliar terms are highlighted and, with a click, definitions appear in a separate window. Multiple-choice "self tests" are given within or following the lesson, and the correct answers are displayed when the user submits his or her own responses.

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Table 1
Examples of CD- or Internet-based Tutorials and the Features They Contain

| Tutorial Number[1] | Medium | Installs Files on User's Computer? | Organization of Material | | Primary Delivery Method | Secondary Delivery Methods | | | Links to: | | | | Student Testing | | Special Features |
			Sequence of Lessons	Table of Contents		Photos / Graphics	Audio / Narration	Video / Animation	Definitions of Terms	PDF Documents	Web pages	Examples, Demos, etc.	Within Lessons	Final Exam	
1	Web	No	X		Text	X			X			X	X	X	
2	CD	No		X	Text	X		X							
3	CD	Yes, minimal installation	X		Narration	X		X					X	X	Background music; remembers previous session
4	CD	Choice of minimal or full installation		X	Text	X				X	X				Expert system for ecosystem classification (EMRIS); nuisance plant identification system (PMIS); searchable vendor lists and alphabetical index (ZMIS)
5	CD	Yes, minimal installation		X	Text	X	X	X	X			X			Closed captioning of audio portions
6	Web	Choice of minimal or full installation	X		Text	X	X						X	X	Registration and password required

[1] 1 – EPA Watershed Academy Web: "Introduction to Watershed Ecology," "Forestry Best Management Practices in Watersheds," "Wetland Functions and Values," U. S. Environmental Protection Agency (*http://www.epa.gov/watertrain/*)
2 – "Hydric Soils Interactive" prepared by the University of Minnesota in cooperation with the USDA-NRCS Wetland Science Institute (dated 1998)
3 – Qualification Training Packages: "Alaska Small Shelter System," "Chemical Agent Monitoring," "All-Purpose Remote Transport System," prepared by Applied Research Associates, Inc., for the Air Force (all version 1.0 dated 2000 or 2001)
4 – "Ecosystem Management and Restoration Information System (EMRIS)," "Noxious and Nuisance Plant Management Information System (PMIS)," "Zebra Mussel Information System (ZMIS)," prepared by the U. S. Army Engineer Research and Development Center, Vicksburg, MS (dated 2001, 1998, and 2000, respectively)
5 – "Learn Microsoft Visual Basic 6.0 Now" by Microsoft Corporation (dated 1998)
6 – "Beginning Microsoft PowerPoint," one of many tutorials on computer topics available to authorized Army users through SmartForce (http://www.smartforce.com)

A similar presentation format was used by the University of Minnesota in their CD-based tutorial "Hydric Soils Interactive," developed for the Natural Resources Conservation Service (Table 1, item 2). The technical content is delivered primarily in text form but is supplemented with simple animations of hydrologic pathways and the like. Furthermore, a clickable flowchart allows the user to jump directly to specific topics without viewing the entire lesson from beginning to end.

A different approach was taken by Applied Research Associates, Inc., in developing instructional CDs for the Air Force (Table 1, item 3). These are almost entirely narrated, with very little text appearing on the screen. Instead, one sees still photographs and occasional videos illustrating the lesson. Test questions are provided both within and at the end of each lesson, and the student gets immediate verbal feedback on the answers ("That is correct" or "Incorrect; try again"). If the rhythmic background music becomes annoying, its volume can be adjusted separately from the narration. Although presented on CD, the system installs files on the user's computer to keep track of previous sessions. Initially, the lessons must be taken in sequence and all parts of the lesson, including clickable hints and warnings, must be viewed before the system allows the user to continue. Subsequently, the lessons can be reviewed in any order.

CD-based information systems on various subjects have been developed by the Environmental Laboratory of ERDC (Table 1, item 4). Although designed more as reference works than tutorials, they have a number of features relevant to instructional software. A detailed table of contents appears at the left of the screen. Clicking on any entry brings up text and images. There are numerous highlighted links to documents in PDF format contained on the CD, or to Internet sources of documents and other information. The CDs also contain special features such as expert systems for ecosystem classification and nuisance plant identification.

An example of a commercially available instructional CD is one produced by Microsoft Corporation (Table 1, item 5). This tutorial combines a clickable expanded outline, introductory videos with sound and optional closed captioning, and clickable links to definitions and illustrations (mostly images of the computer screen showing drop-down menus and the like). Optional demonstrations with audio accompaniment can be paused and resumed by clicking the window.

Army users have access to numerous instructional modules on computer-related subjects through SmartForce® (*http://www.smartforce.com*) (Table 1, item 6). For some selections, users can choose "audio-enabled" or text versions of a course, and can either download the tutorial to their own computers or choose "liveplay" over the Internet.

DESIGNING A WETLAND DELINEATION TUTORIAL: No amount of interaction with a computer can provide the new regulator with the field skills required of a successful wetland delineator. However, most of the classroom portions of the Regulatory IV training course could be developed into self-taught instructional modules and delivered to users on a CD or over the Internet. The only serious drawback of this approach is the lack of interaction with and feedback from an experienced instructor, and even this problem might be ameliorated through e-mail links to instructors at ERDC and elsewhere, or through interaction with designated wetland delineation mentors in each District.

Due to time and funding constraints, 2 or 3 years of effort may be required to develop instructional modules for the full range of topics covered in Regulatory IV. Therefore, a phased approach is warranted. Initial efforts should focus on the core issues of wetland delineation, including the fundamentals of hydrophytic vegetation, hydric soils, and wetland hydrology, and how they are recognized in the field. Subsequent efforts could address the subjects of offsite and onsite delineation methods, disturbed and problem wetlands, developing delineation reports, and so forth.

Desirable features of a wetland delineation tutorial include most of those listed in Table 1. However, actual implementation will be limited mainly by cost. Cost-effectiveness dictates that much of the content will likely be delivered as text interspersed with photographs, drawings, and other images. However, occasional narration, video clips, and animation are essential to break the monotony of text and to maximize understanding and retention of certain topics.

STEPS IN THE IMPLEMENTATION OF A WETLAND DELINEATION TUTORIAL:
Development and implementation of the tutorial will follow these steps:

1. Select the topics for implementation as instructional modules. Because of the long history of the Regulatory IV course, the important topics in wetland delineation are already well-defined. Those selected for initial implementation are listed in Figure 1. Eight topics will be targeted, starting with an introductory module on wetland definitions, delineation manuals, and the overall technical approach for wetland identification. Module 2 will address preliminary gathering of maps and other offsite reference data. Modules 3, 4, and 5 will provide the essential background on hydrology, vegetation, and soils that underlies wetland criteria and field indicators, which will be presented in Modules 6, 7, and 8.

2. Draft the text for each module. The content of each module is outlined in Figure 1. Most of this content will be presented as text on the computer screen, although some may be delivered by a narrator. In either case, a complete transcript of each lesson will be required.

3. Assemble graphics. Many of the images illustrating each lesson can be drawn from the Regulatory IV PowerPoint® presentations recently developed by ERDC's Environmental Laboratory. Additional images may be scanned from existing 35-mm slides or drawn by graphic artists.

4. Assemble supplementary information and links. These include lists of technical terms and their definitions, supplementary documents in digital form, and links to important Web pages.

5. If desired, develop animated sequences, videos, expert systems, and narration.

6. Develop the computer application. The tutorial will be developed using Borland's Delphi® applications software for the Windows environment. Planning and implementing the computerized application will actually occur simultaneously with previous steps.

7. Test and distribute to users. The completed software will be subject to a number of tests to ensure that it runs properly on different platforms in both CD- and Web-based versions. The final step is to distribute copies of the CD version to all District Regulatory offices and place an Internet-enabled version on the ERDC Web site.

1. **Module 1: Introduction and Basic Approach**
   a. Objectives of this lesson
   b. Why delineate wetlands?
   c. Relevant Federal laws
      i. Clean Water Act
      ii. National Food Security Act
   d. Regulatory definitions of wetlands
      i. Corps/EPA definition
      ii. Food Security Act definition
   e. Delineation manuals
      i. Corps of Engineers Wetlands Delineation Manual (the Corps Manual)
      ii. National Food Security Act Manual (NFSAM)
      iii. Purpose
      iv. Wetlands versus other regulated waters of the U. S.
   f. Diagnostic characteristics of wetlands
      i. Hydrophytic vegetation
      ii. Hydric soils
      iii. Wetland hydrology
   g. The 3-parameter approach to wetland delineation
      i. "Normal circumstances" and wetland delineation in disturbed areas
      ii. Role of flexibility and good judgment
   h. Self test

2. **Module 2: Preliminary Data Gathering**
   a. Objectives of this lesson
   b. Role of offsite data in wetland delineation
   c. Information sources
      i. U. S. Geological Survey topographic maps
      ii. National Wetlands Inventory maps
      iii. USDA soil survey reports
         1. General soils map
         2. Detailed soil map sheets
         3. Map unit descriptions
         4. Soil series descriptions
         5. Data tables
      iv. Hydric soils list
      v. Aerial photographs
      vi. Hydrologic data
      vii. Planning documents (environmental impact statements, special area management plans)
      viii. Detailed project plans
   d. Self test

3. **Module 3: Introduction to Hydrology and Soil Chemistry**
   a. Objectives of this lesson
   b. Wetland water budgets
      i. Inputs and outputs
      ii. Annual variability

Figure 1. Preliminary content outline for initial implementation of a wetland delineation tutorial (Sheet 1 of 3)

    c. Wetlands in landscapes (a hydrogeomorphic tour)
- i. Depressions
- ii. Lacustrine and coastal fringes
- iii. Riverine (floodplain) wetlands
- iv. Slopes
- v. Flats

    d. Some basic hydrologic terms
- i. Inundation, flooding, ponding, saturation, water table, capillary fringe

    e. Chemistry of wet soils
- i. Anaerobiosis and reduction
- ii. The oxidation/reduction sequence
- iii. Factors affecting rates of reduction in natural soils

    f. Self test

4.   Module 4: Introduction to Wetland Vegetation
- a. Objectives of this lesson
- b. The concept of hydrophytic vegetation
- c. Plant adaptations for life in wetlands
  - i. Morphological
  - ii. Physiological
  - iii. Reproductive
- d. List of plant species that occur in wetlands
  - i. Wetland indicator status
    - 1. Examples
  - ii. Plant list regions
  - iii. Using the plant list
- e. Selecting dominant plant species
  - i. Measures of plant species dominance
  - ii. Vegetation strata
  - iii. The "50/20 rule"
  - iv. An example
- f. Self test

5.   Module 5: Introduction to Soil Properties and Descriptions
- a. Objectives of this lesson
- b. What is soil?
- c. Major soil-forming factors
- d. Key soil properties
  - i. Color
    - 1. The Munsell color system (hue, value, chroma)
    - 2. Reading soil colors
    - 3. Describing color patterns in soils
      - a. Matrix and mottles (redoximorphic features)
      - b. Mottle contrast, abundance, and size
  - ii. Organic versus mineral materials
  - iii. Texture
    - 1. Relative sizes of soil particles
    - 2. Textural classes
  - iv. Horizons and their designation
  - v. Permeability and drainage
- e. Self test

Figure 1. (Sheet 2 of 3)

6. **Module 6: Wetland Hydrology Criteria and Field Indicators**
   a. Objectives of this lesson
   b. Criteria
       i. Corps manual "criteria"
       ii. Comparison with NFSAM criteria
       iii. Growing season
           1. Definition
           2. How to determine growing season length and dates
       iv. Kinds of hydrologic data needed to evaluate criteria
       v. Sources of hydrologic data
   c. Field indicators
       i. Primary indicators
       ii. Secondary indicators
   d. Evaluating antecedent meteorological conditions
   e. Self test

7. **Module 7: Hydrophytic Vegetation Basic Rule and Other Indicators**
   a. Objectives of this lesson
   b. The Corps manual's "basic rule"
       i. FAC-neutral test (cross-reference with wetland hydrology field indicators)
   c. Other indicators of hydrophytic vegetation
   d. Examples
   e. Self test

8. **Module 8: Hydric Soil Definition, Criteria, and Field Indicators**
   a. Definition
   b. Criteria
       i. Use in generating hydric soils lists
       ii. National, state, and local hydric soil lists
   c. Field indicators (Corps manual)
       i. Non-sandy soils
       ii. Sandy soils
   d. Self test

Figure 1. (Sheet 3 of 3)

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